



Coordination Tools for HAD-System Testing

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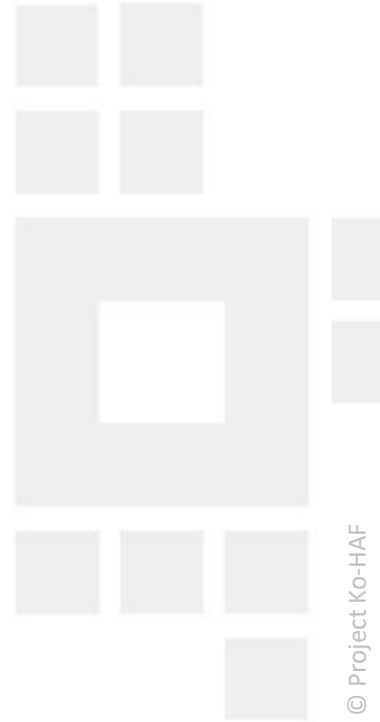
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aufgrund eines Beschlusses
des Deutschen Bundestages

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Goal

- Reproducible system tests in real scenarios with company vehicles
- Coordination between test vehicle and company vehicles (who must be where)
- Keeping of test conditions (distances, velocities, lateral positions, ...)
- Reference data from test and company vehicles for evaluation
 - Check of keeping the test conditions
 - Evaluation of test vehicle behavior (legal / safety / comfort requirements)
 - Evaluation of sensor accuracy (distance, velocity, lateral position)



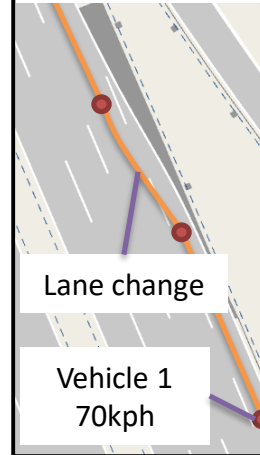
Concept "TestAssist" Plan+Sim

Planning
Testcase + HD-Map

Testrun Simulation
Optimization
Briefing Testdriver

TF-ID	Typ	Rahmenbedingung	Beschreibung	Wert	
TK_113	1.1	Testfall		AP5 Absicherung - Erprobung und Validierung UAP5.2 Testprozedur Testkatalog Auffahrt ohne Vorausfahrenden in ausreichend große Lücke	
TK_113	1.1.1	Szenarie Element	Rampe		
TK_113	1.1.2	Szenarie Element	Beschleunigungssteifen		
TK_113	1.1.3	Szenarie Element	Durchgehender Fahstreifen		
TK_113	1.1.4	Szenarie Element	Verkehrsregelung		
TK_113	1.1.5	Dynamisches Element	Verkehr		
TK_113	1.1.5.1	Dyn. Rahmenbedingung	Verkehr	Anzahl Targets 2	
TK_113	1.1.5.2	Sequenz	Verkehr	Egofahrzeu	
TK_113	1.1.5.2.1	Testschritt	Verkehr	Egofahrzeu Initialwer Startspur	Rampe
TK_113	1.1.5.2.2	Testschritt	Verkehr	Egofahrzeu Initialwer Startpunkt	160
TK_113	1.1.5.2.3	Testschritt	Verkehr	Egofahrzeu Initialwer Funktion	ja
TK_113	1.1.5.2.4	Testschritt	Verkehr	Egofahrzeu Initialwer Geschwindigkeit	60
TK_113	1.1.5.2.5	Testschritt	Verkehr	Egofahrzeu Zielwert Spunwechsel	190
TK_113	1.1.5.2.6	Testschritt	Verkehr	Egofahrzeu Initialwer Endpunkt	300
TK_113	1.1.5.3	Sequenz	Verkehr	Target 1	
TK_113	1.1.5.3.1	Testschritt	Verkehr	Target 1 Initialwer Startspur	1
TK_113	1.1.5.3.2	Testschritt	Verkehr	Target 1 Initialwer Beschleunigung	0
TK_113	1.1.5.3.3	Testschritt	Verkehr	Target 1 Initialwer Geschwindigkeit	90
TK_113	1.1.5.3.4	Testschritt	Verkehr	Target 1 Zustand Startpunkt Spunwechsel Ego	240
TK_113	1.1.5.4	Sequenz	Verkehr	Target 2	
TK_113	1.1.5.4.1	Testschritt	Verkehr	Target 2 Initialwer Startspur	1
TK_113	1.1.5.4.2	Testschritt	Verkehr	Target 2 Initialwer Beschleunigung	0
TK_113	1.1.5.4.3	Testschritt	Verkehr	Target 2 Initialwer Geschwindigkeit	90
TK_113	1.1.5.4.4	Testschritt	Verkehr	Target 2 Zustand Abstand	100

OpenDrive Map

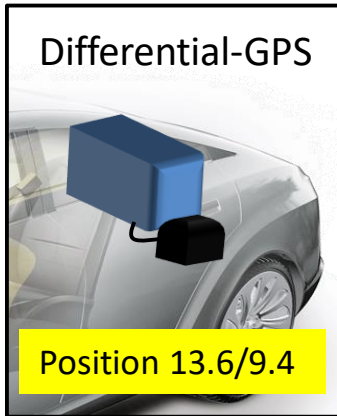


Storyboard Table, Vehicle 1, 2, 3, ...

Time	Position	Velocity	Attribut
0.001	13.4/9.7	19.5	LaneC2
0.021	13.6/9.4	19.7	VeloC5
0.041	13.8/9.2	20.1	LaneC1
:

Concept “TestAssist“ Match+Sync

Target Localization
Realtime Position,
Velocity and Acceleration



Match Position
Real to Target Story

Storyboard Table, Vehicle 1 (Target)			
Time	Position	Velocity	Attribut
0.001	13.4/9.7	19.5	LaneC2
0.021	13.6/9.4	19.7	VeloC5
0.041	13.8/9.2	20.1	LaneC1
:

Synchronization
Storyboard
Target to Slave

Storyboard Table, Vehicle 2 (Slave)			
Time	Position	Velocity	Attribut
0.001	14.1/9.3	19.5	
0.021	14.3/9.4	19.7	VeloC3
0.041	14.5/9.5	20.1	LaneC5
:

Concept "TestAssist" Sync+Calc

Synchronization

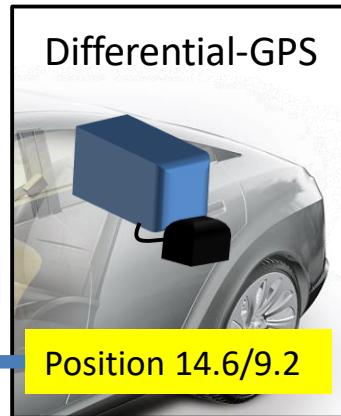
Storyboard
Real to Slave Story

Storyboard Table, Vehicle 2 (Slave)

Time	Position	Velocity	Attribut
0.001	14.1/9.3	19.5	
0.021	14.3/9.4	19.7	VeloC3
0.041	14.5/9.5	20.1	LaneC5
:

Slave Localization

Realtime Position,
Velocity and Acceleration

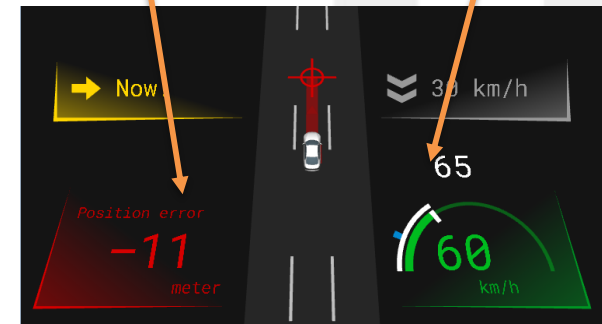


Calculation HMI

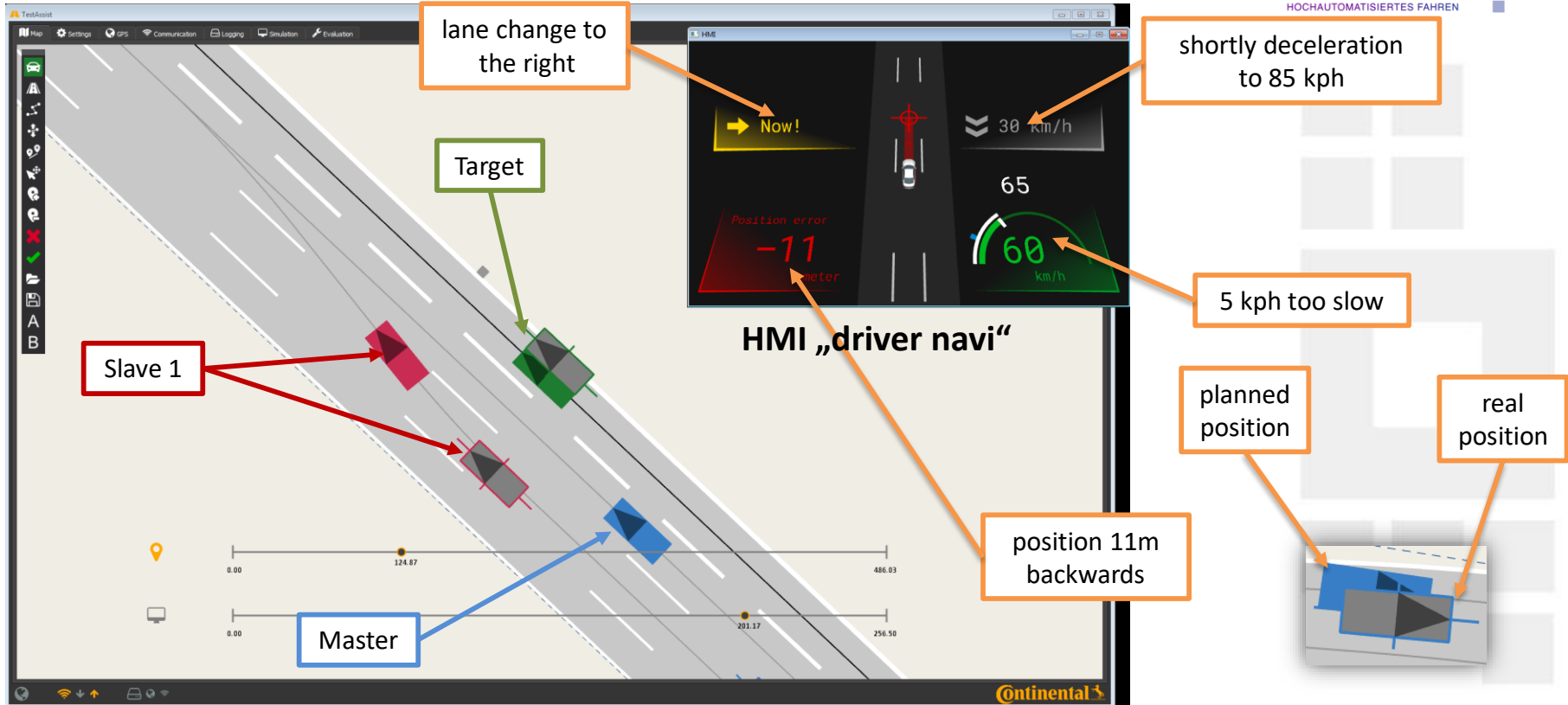
Real to Target Story

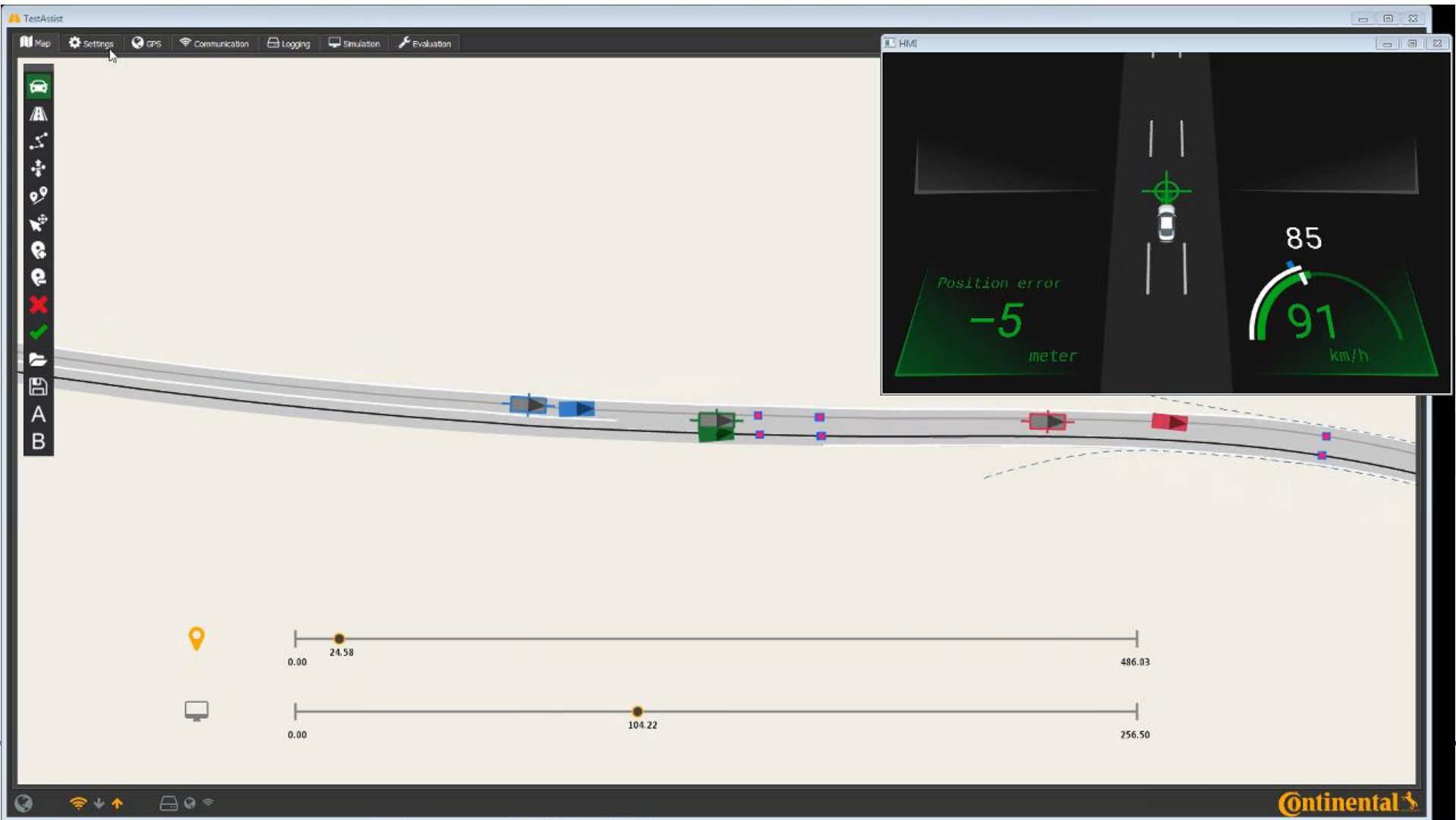
Calculated
position
deviation

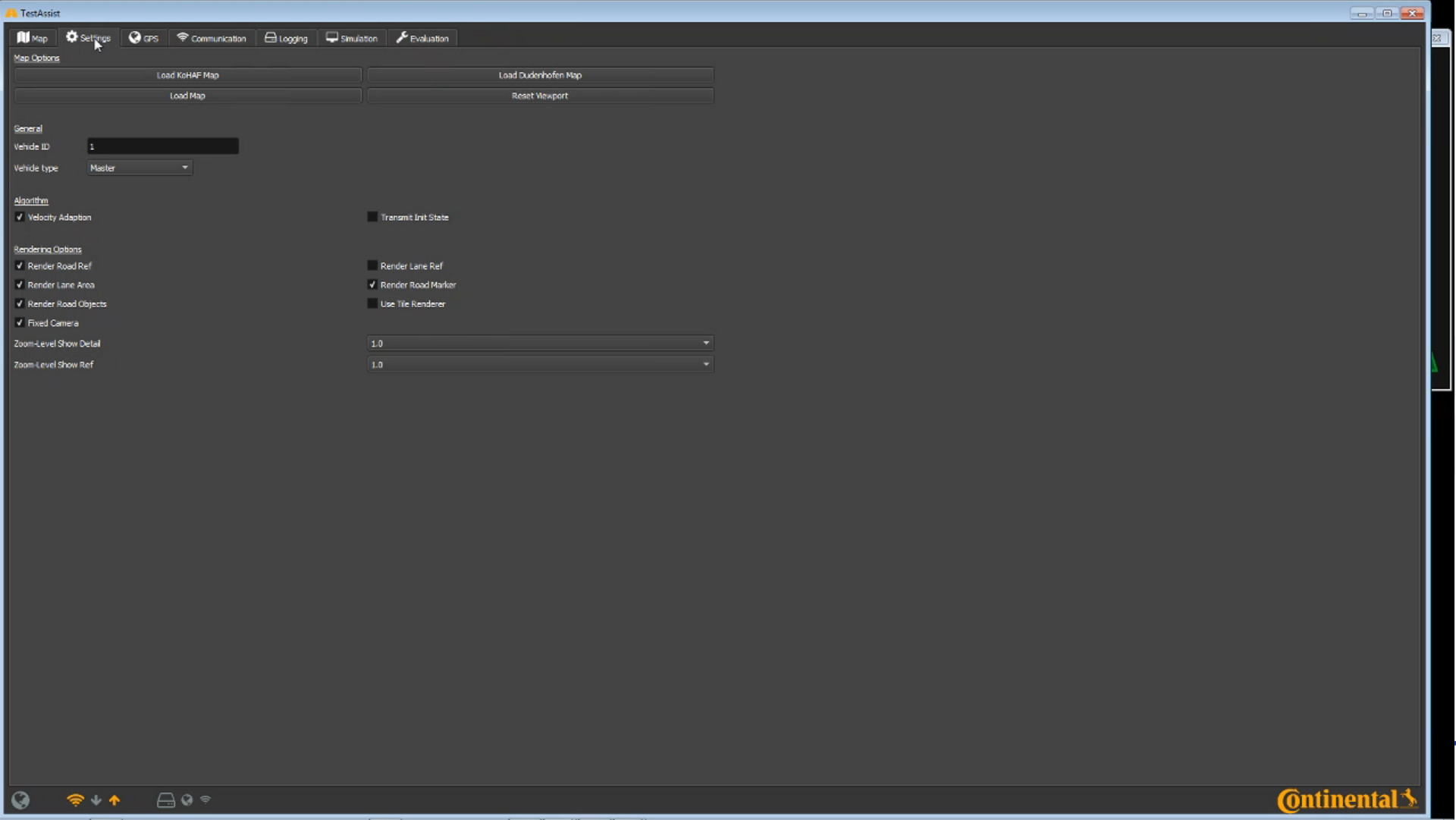
Calculated
velocity to hit
the position



Concept "TestAssist" Software







Map Options

Load KohAF Map Load Dudenhofen Map

Load Map Reset Viewport

General

Vehicle ID: 1

Vehicle type: Master

Algorithm

Velocity Adaption Transmit Init State

Rendering Options

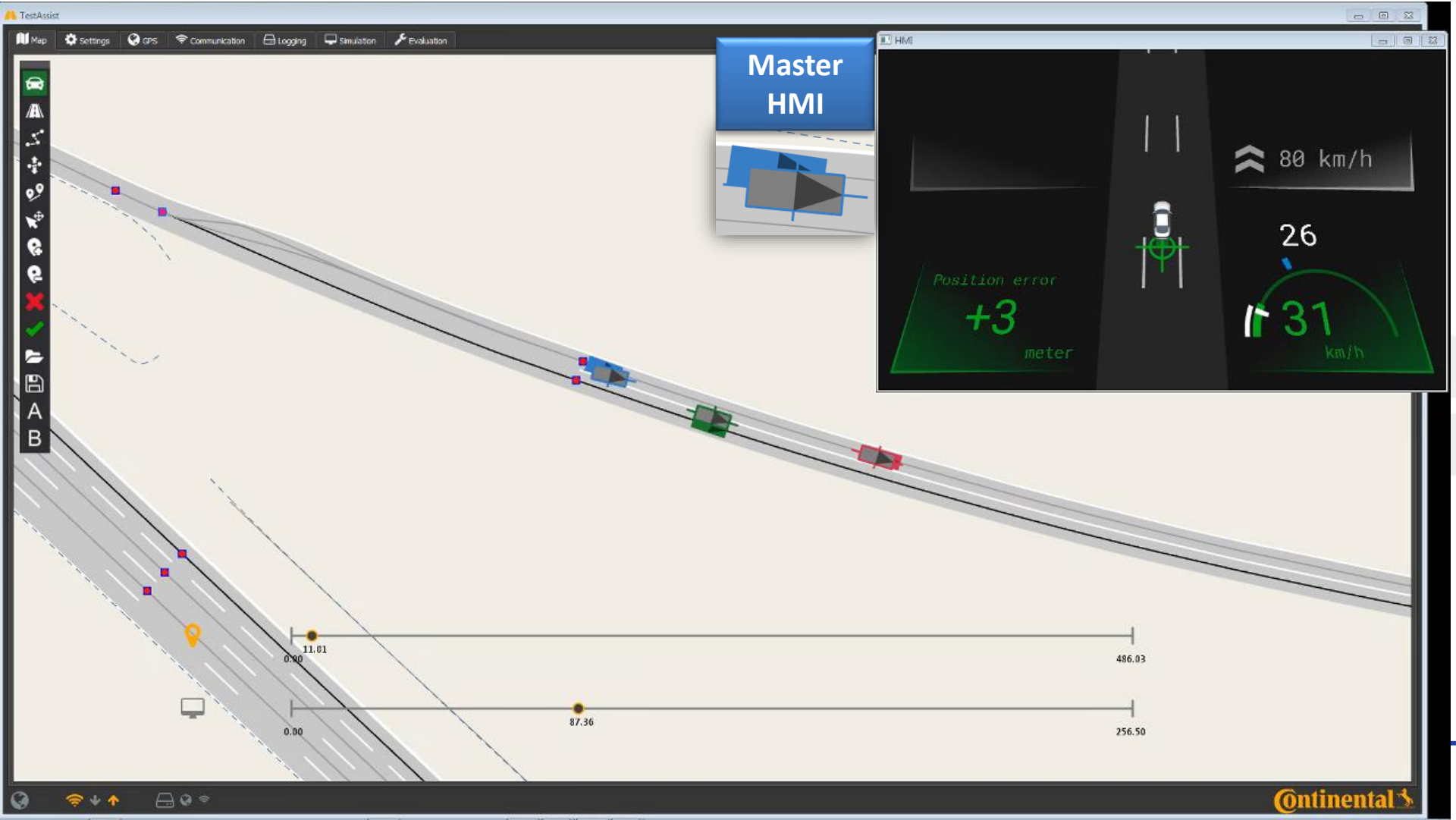
Render Road Ref Render Lane Ref

Render Lane Area Render Road Marker

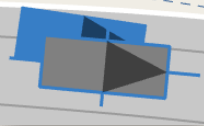
Render Road Objects Use Tile Renderer

Zoom-Level Show Detail: 1.0

Zoom-Level Show Ref: 1.0



Master HMI

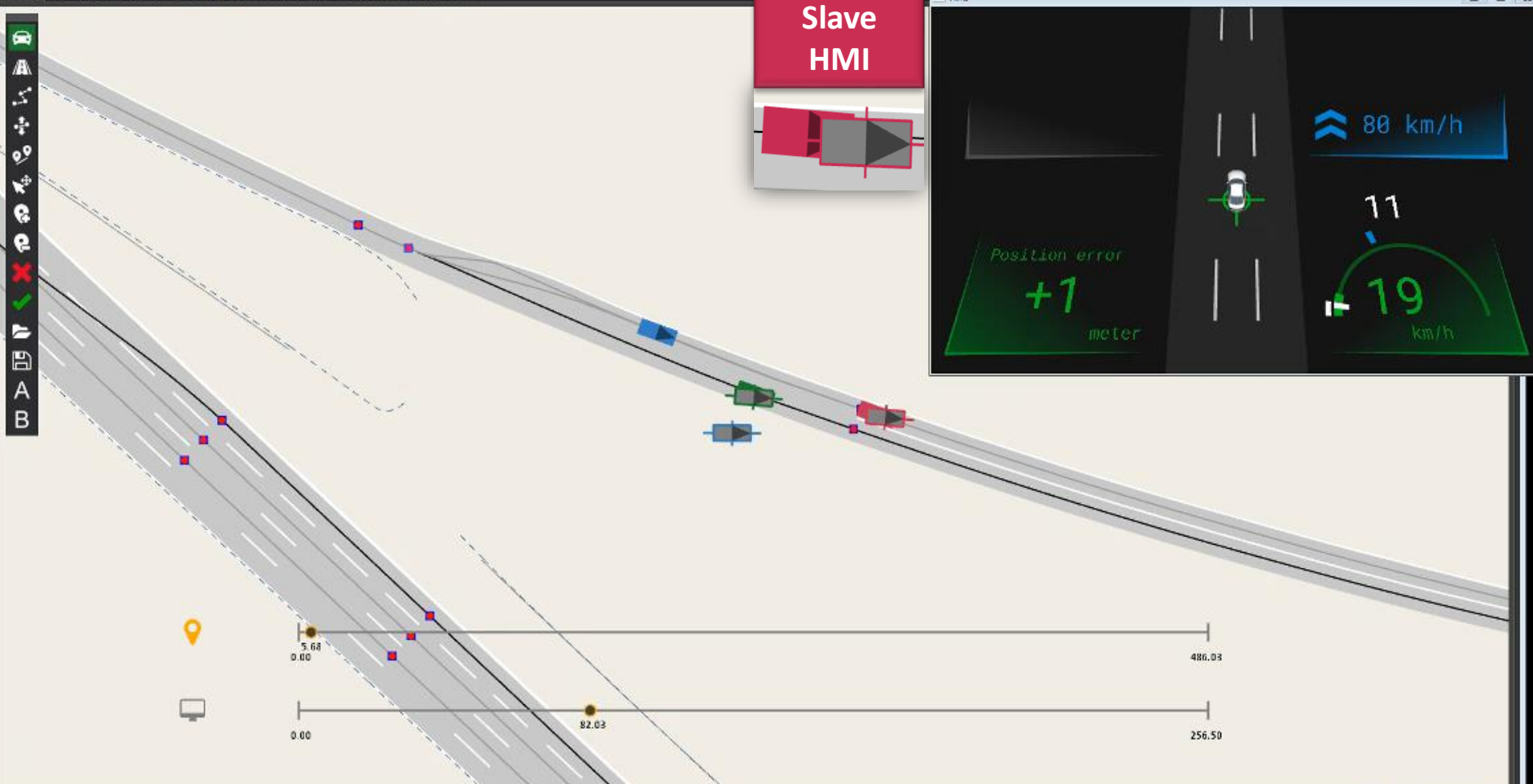
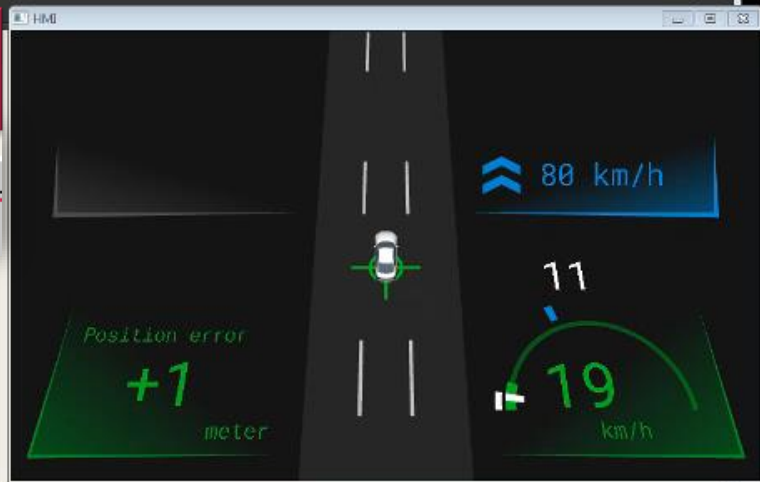
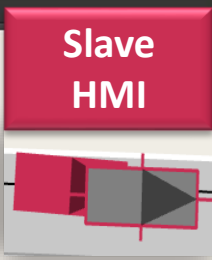


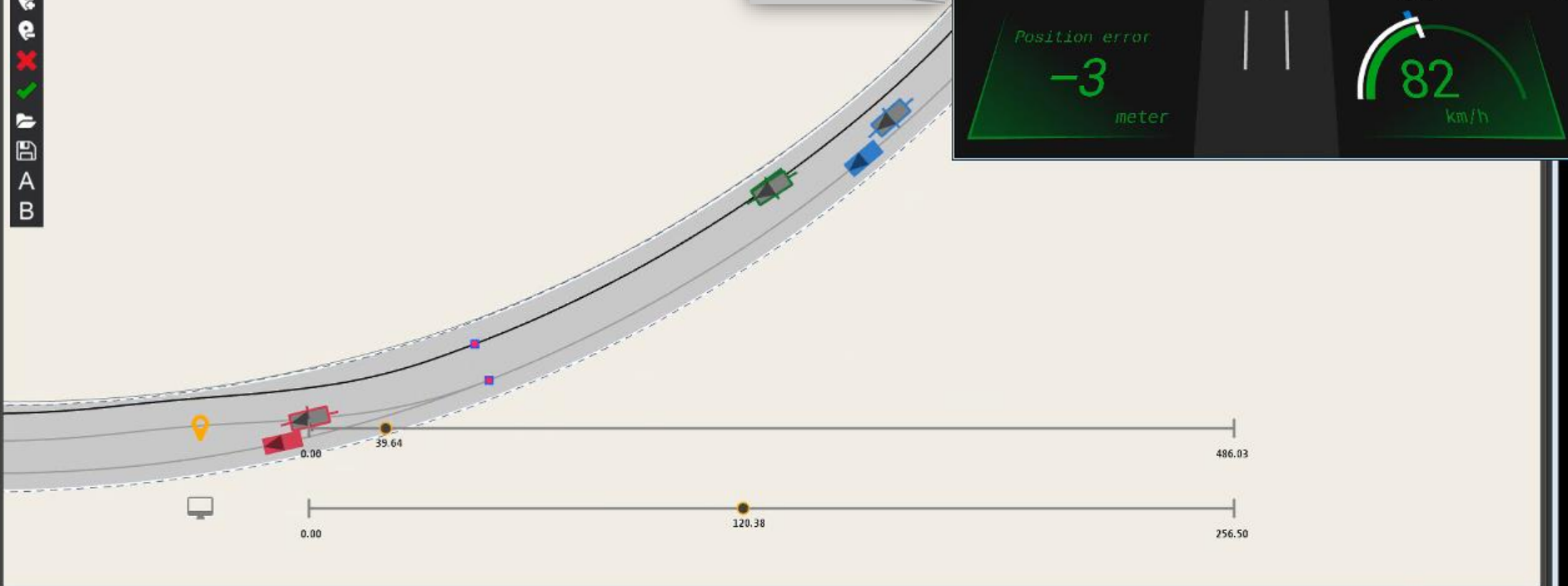
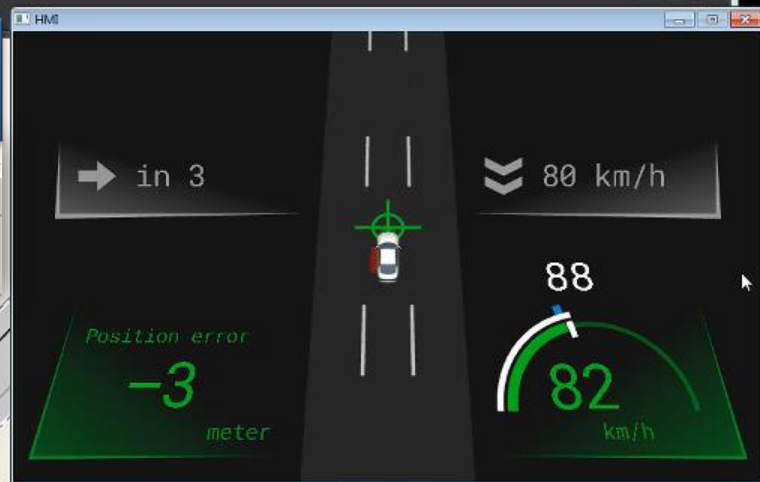
HMI

80 km/h

Position error
+3
meter

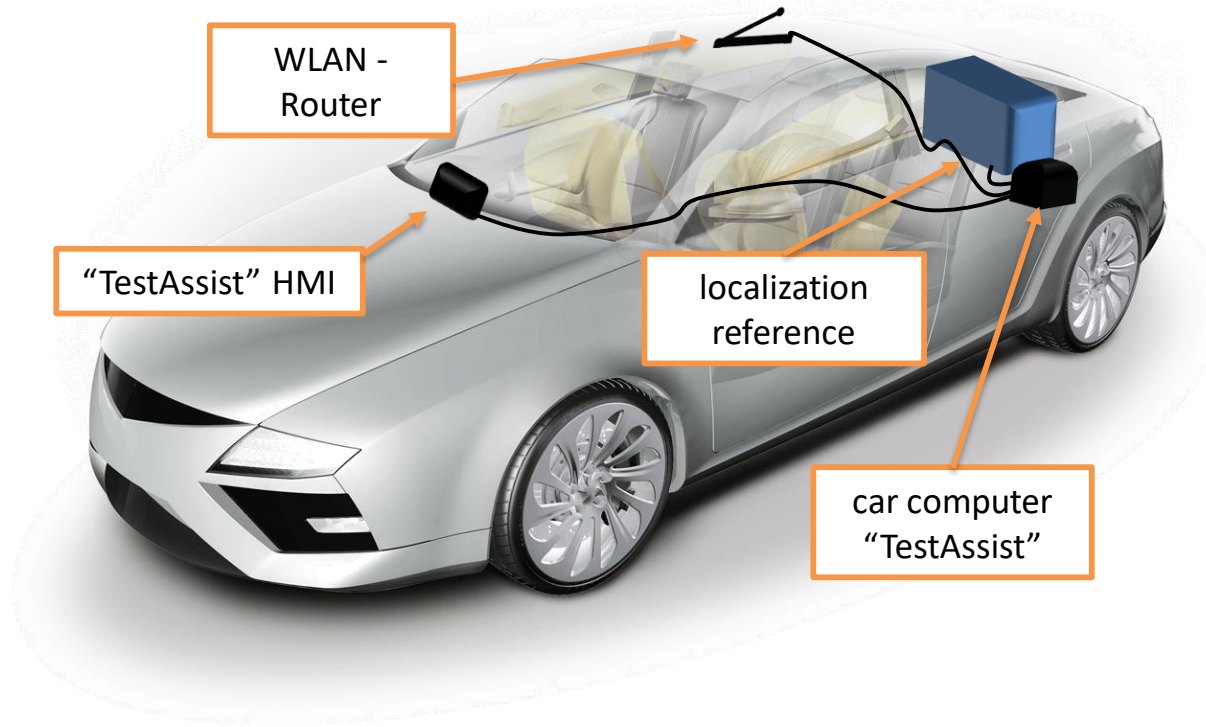
26
31
km/h







Concept “TestAssist“ Hardware



Conclusion Tool “TestAssist“

- Planning scenarios for each vehicle (Target, Master, Slave 1 and 2)
- A high accurate map is used (OpenDrive)
- Simulation of planned scenarios with moving vehicles – useful for:
 - Briefing test drivers
 - Optimizing the test case
- Definition of the test case is saved in a “json” file
- Positioning & moving data from a test run are saved in a “Logging” file (10 to 20ms step)
- Replaying of test runs and comparison real vs. planned test cases
 - ➔ **Related to absolute positions based on topographical surroundings**



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